

CLAIMS

What is claimed is:

1. A light emitting device having a high resistivity cushion layer, comprising:

a substrate;

a first cladding layer formed on the substrate;

an active layer formed on the first cladding layer;

a second cladding layer formed on the active layer;

a cushion layer formed on the second cladding layer and having a resistivity higher than that of the second cladding layer;

a contact layer formed on the cushion layer; and

a transparent conductive layer formed on the contact layer.
2. A light emitting device having a high resistivity cushion layer according to claim 1, wherein the active layer comprises AlGaInP.
3. A light emitting device having a high resistivity cushion layer according to claim 1, wherein the active layer comprises a multiple quantum well structure.
4. A light emitting device having a high resistivity cushion layer according to claim 1, wherein the cushion layer comprises a material selected from a group consisting of GaP, GaAsP, GaInP and AlGaAs.

5. A light emitting device having a high resistivity cushion layer according to claim 1, wherein the cushion layer comprises AlGaInP.
6. A light emitting device having a high resistivity cushion layer according to claim 1, wherein the contact layer comprises a material selected from a group consisting of GaP, GaAsP, GaInP, GaAs, AlGaAs, Be/Au, Zn/Au, Ge/Au and Ge.
7. A light emitting device having a high resistivity cushion layer according to claim 6, wherein the contact layer comprises a semiconductor material doped with carbon.
8. A light emitting device having a high resistivity cushion layer according to claim 1, wherein the transparent conductive layer comprises a material selected from a group consisting of indium tin oxide, cadmium tin oxide, antimony tin oxide, magnesium oxide, zinc oxide and zinc tin oxide.
9. A light emitting device having a high resistivity cushion layer according to claim 1, wherein the transparent conductive layer comprises a material selected from a group consisting of indium oxide and tin oxide.
10. A light emitting device having a high resistivity cushion layer according to claim 1, wherein the substrate comprises a material selected from a group consisting of Si, Ge, GaAs, GaP, AlGaAs and GaAsP.
11. A light emitting device having a high resistivity cushion layer according to claim 1, wherein the first cladding layer or the second cladding layer comprises AlGaInP or AlInP.

12. A light emitting device having a high resistivity cushion layer according to claim 1, further comprising a DBR formed between the substrate and the first cladding layer.
13. A light emitting device having a high resistivity cushion layer according to claim 12, wherein the DBR comprises a material selected from a group consisting of AlGaInP, AlGaAs and AlAs.
14. A light emitting device having a high resistivity cushion layer according to claim 1, wherein the device is a surface emitting device.
15. A light emitting device having a high resistivity cushion layer, comprising:
- a first electrode;
 - a substrate formed on the first electrode;
 - a first cladding layer formed on the substrate;
 - an active layer formed on the first cladding layer;
 - a second cladding layer formed on the active layer;
 - a cushion layer formed on the second cladding layer and having a resistivity higher than that of the second cladding layer;
 - a contact layer formed on the cushion layer for providing an ohmic contact, the contact layer being formed with a through hole that exposes a portion of the cushion layer;
 - a transparent conductive layer formed on the contact layer and filling in the through hole in the contact layer; and

a second electrode formed on a portion of the transparent conductive layer, the second electrode being approximately aligned with the through hole in the contact layer.

16. A light emitting device having a high resistivity cushion layer according to claim 15, wherein the active layer comprises AlGaInP.

17. A light emitting device having a high resistivity cushion layer according to claim 15, wherein the active layer comprises a multiple quantum well structure.

18. A light emitting device having a high resistivity cushion layer according to claim 15, wherein the cushion layer comprises a material selected from a group consisting of GaP, GaAsP, GaInP and AlGaAs.

19. A light emitting device having a high resistivity cushion layer according to claim 15, wherein the cushion layer comprises AlGaInP.

20. A light emitting device having a high resistivity cushion layer according to claim 15, wherein the contact layer comprises a material selected from a group consisting of GaP, GaAsP, GaInP, GaAs, AlGaAs, Be/Au, Zn/Au, Ge/Au and Ge.

21. A light emitting device having a high resistivity cushion layer according to claim 20, wherein the contact layer comprises a semiconductor material doped with carbon.

22. A light emitting device having a high resistivity cushion layer according to claim 15, wherein the transparent conductive layer comprises a material selected from a group consisting of indium tin oxide, cadmium tin oxide, antimony tin oxide, magnesium oxide, zinc oxide and zinc tin oxide.

23. A light emitting device having a high resistivity cushion layer according to claim 15, wherein the transparent conductive layer comprises a material selected from a group consisting of indium oxide and tin oxide.
24. A light emitting device having a high resistivity cushion layer according to claim 15, wherein the substrate comprises a material selected from a group consisting of Si, Ge, GaAs, GaP, AlGaAs and GaAsP.
25. A light emitting device having a high resistivity cushion layer according to claim 15, wherein the first cladding layer or the second cladding layer comprises AlGaInP or AlInP.
26. A light emitting device having a high resistivity cushion layer according to claim 15, further comprising a DBR formed between the substrate and the first cladding layer.
27. A light emitting device having a high resistivity cushion layer according to claim 26, wherein the DBR comprises a material selected from a group consisting of AlGaInP, AlGaAs and AlAs.
28. A light emitting device having a high resistivity cushion layer according to claim 15, wherein the device is a surface emitting device.
29. A light emitting device having a high resistivity cushion layer, comprising:
- a substrate;
 - an active layer;
 - a first cladding layer between the substrate and the active layer;

a second cladding layer;

a cushion layer having a resistivity higher than the second cladding layer, wherein the second cladding layer is between the active layer and the cushion layer;

a transparent conductive layer; and

a contact layer interposed between at least a portion of the cushion layer and at least a portion of the transparent conductive layer.

30. A light emitting device having a high resistivity cushion layer according to claim 29, wherein the active layer comprises AlGaInP.

31. A light emitting device having a high resistivity cushion layer according to claim 29, wherein the active layer comprises a multiple quantum well structure.

32. A light emitting device having a high resistivity cushion layer according to claim 29, wherein the cushion layer comprises a material selected from a group consisting of GaP, GaAsP, GaInP and AlGaAs.

33. A light emitting device having a high resistivity cushion layer according to claim 29, wherein the cushion layer comprises AlGaInP.

34. A light emitting device having a high resistivity cushion layer according to claim 29, wherein the contact layer comprises a material selected from a group consisting of GaP, GaAsP, GaInP, GaAs, AlGaAs, Be/Au, Zn/Au, Ge/Au and Ge.

35. A light emitting device having a high resistivity cushion layer according to claim 34, wherein the contact layer comprises a semiconductor material doped with carbon.

36. A light emitting device having a high resistivity cushion layer according to claim 29, wherein the transparent conductive layer comprises a material selected from a group consisting of indium tin oxide, cadmium tin oxide, antimony tin oxide, magnesium oxide, zinc oxide and zinc tin oxide.

37. A light emitting device having a high resistivity cushion layer according to claim 29, wherein the transparent conductive layer comprises a material selected from a group consisting of indium oxide and tin oxide.

38. A light emitting device having a high resistivity cushion layer according to claim 29, wherein the substrate comprises a material selected from a group consisting of Si, Ge, GaAs, GaP, AlGaAs and GaAsP.

39. A light emitting device having a high resistivity cushion layer according to claim 29, wherein the first cladding layer or the second cladding layer comprises AlGaInP or AlInP.

40. A light emitting device having a high resistivity cushion layer according to claim 29, further comprising a DBR formed between the substrate and the first cladding layer.

41. A light emitting device having a high resistivity cushion layer according to claim 40, wherein the DBR comprises a material selected from a group consisting of AlGaInP, AlGaAs and AlAs.

42. A light emitting device having a high resistivity cushion layer according to claim 29, wherein the device is surface emitting.

43. A light emitting device having a high resistivity cushion layer, comprising:

a substrate;

an active layer;

a first cladding layer between the substrate and the active layer;

a second cladding layer;

a cushion layer having a resistivity higher than the second cladding layer, wherein the second cladding layer is between the active layer and the cushion layer;

a transparent conductive layer; and

a contact layer having a through hole interposed between a portion of the cushion layer and a first portion of the transparent conductive layer, and wherein a second portion of the transparent conductive layer fills in the through hole to form a Schottky barrier.

44. A light emitting device having a high resistivity cushion layer according to claim 43, wherein the active layer comprises AlGaInP.

45. A light emitting device having a high resistivity cushion layer according to claim 43, wherein the active layer comprises a multiple quantum well structure.

46. A light emitting device having a high resistivity cushion layer according to claim 43, wherein the cushion layer comprises a material selected from a group consisting of GaP, GaAsP, GaInP and AlGaAs.

47. A light emitting device having a high resistivity cushion layer according to claim 43, wherein the cushion layer comprises AlGaInP.

48. A light emitting device having a high resistivity cushion layer according to claim 43, wherein the contact layer comprises a material selected from a group consisting of GaP, GaAsP, GaInP, GaAs, AlGaAs, Be/Au, Zn/Au, Ge/Au and Ge.
49. A light emitting device having a high resistivity cushion layer according to claim 48, wherein the contact layer comprises a semiconductor material doped with carbon.
50. A light emitting device having a high resistivity cushion layer according to claim 43, wherein the transparent conductive layer comprises a material selected from a group consisting of indium tin oxide, cadmium tin oxide, antimony tin oxide, magnesium oxide, zinc oxide and zinc tin oxide.
51. A light emitting device having a high resistivity cushion layer according to claim 43, wherein the transparent conductive layer comprises a material selected from a group consisting of indium oxide and tin oxide.
52. A light emitting device having a high resistivity cushion layer according to claim 43, wherein the substrate comprises a material selected from a group consisting of Si, Ge, GaAs, GaP, AlGaAs and GaAsP.
53. A light emitting device having a high resistivity cushion layer according to claim 43, wherein the first cladding layer or the second cladding layer comprises AlGaInP or AlInP.
54. A light emitting device having a high resistivity cushion layer according to claim 43, further comprising a DBR formed between the substrate and the first cladding layer.

55. A light emitting device having a high resistivity cushion layer according to claim 54, wherein the DBR comprises a material selected from a group consisting of AlGaInP, AlGaAs and AlAs.

56. A light emitting device having a high resistivity cushion layer according to claim 43, wherein the device is surface emitting.

57. A device having a high resistivity cushion layer, comprising:

a transparent conductive layer disposed on a substrate, wherein at least a first cladding layer, an active layer, a second cladding layer, and a cushion layer having a resistivity higher than the second cladding layer are interposed between the substrate and transparent conductive layer in the referenced order, and further wherein a contact layer is interposed between at least a portion of the cushion layer and a at least a portion of the transparent conductive layer.

58. A light emitting device having a high resistivity cushion layer according to claim 58, wherein the device is surface emitting.